1990

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Recommended Citation
Gertjejansen, R. O.; Ritter, D. C.; Popowitz, B. A. 1990. Paper birch as a core material for aspen oriented strandboard and waferboard. Aspen Symposium '89 : Proceedings. General Technical Report NC-140. North Central Forest Experiment Station Forest Service, U.S. Department of Agriculture St. Paul, Minnesota. 311-314.

PAPER BIRCH AS A CORE MATERIAL FOR ASPEN ORIENTED STRANDBOARD AND WAFERBOARD

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ABSTRACT.--Thin paper birch strands and wafers, when used for the cores (33 percent by weight) of laboratory PF bonded aspen oriented strandboards (OSB) and waferboards (WB), resulted in properties that were equal to or better than those of all-aspen OSBs and WBs when compared over a density range of 37-43 PCF. Properties evaluated were internal bond (IB), moduli of elasticity and rupture (MOR), and, after a 2-hour boil bond durability test, thickness swelling (TS), linear expansion, and loss of MOR. Thick birch core geometries generally had deleterious effects on the critical core properties of IB and TS.

INTRODUCTION

The overall goal of an on-going project in the Department of Forest Products is to increase the use of underutilized Lake States hardwoods for wood base structural composite panels. The specific objective of this study was to determine if paper birch (Betula papyrifera), an underutilized hardwood, could be used as the core material for aspen oriented strandboard (OSB) and waferboards (WB). The potential benefits of utilizing paper birch as a core material in OSB and WB include reduced raw material costs for the manufacturer, greater raw material flexibility for the manufacturer, greater flexibility for the forest manager, and increased profits for the woodland owner.

PROCEDURE

Laboratory aspen OSBs and WBs, each made with four different paper birch core strand/wafer geometries (33 percent by weight), were compared to all-aspen boards over a density range of 37 to 43 PCF. All boards were bonded with phenol formaldehyde (PF) resin. Resin spreads on all strands and wafers were constant and equal to those obtained with commercial aspen strands and wafers at 5.0 percent liquid PF solids for strands and 2.2 percent powder PF solids for wafers. The strand and wafer dimensions are in Table 1 and manufacturing parameters are in Table 2.

Standard mechanical properties evaluated were internal bond strength (IB) and moduli of rupture (MOR) and elasticity (MOE). In addition, a 2-hour boil bond durability test was used to determine linear expansion (LE), total (TS) and irreversible (ITS) thickness swellings, and loss of MOR and MOE.

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Table 1.--Furnish geometry.

Furnish Type	Target Dimensions (inches) OSB	Target Dimensions (inches) WB
Face, Commercial Aspen	0.030 x 0.33 x 2.25	0.036 x 1.50 x 3.0
Core, Paper Birch Thick-Narrow	0.040 x 0.25 x 3.00	0.036 x 0.50 x 3.0
Core, Paper Birch Thick-Wide	0.040 x 0.70 x 3.00	0.036 x 2.00 x 3.0
Core, Paper Birch Thin-Narrow	0.020 x 0.25 x 3.00	0.020 x 0.50 x 3.0
Core, Paper Birch Thin-Wide	0.020 x 0.70 x 3.00	0.020 x 2.00 x 3.0
Core, Commercial Aspen	0.030 x 0.33 x 2.25	0.036 x 1.50 x 3.0

Table 2.--Manufacturing parameters for experimental panels.

Parameter	OSB	WB
Face Material	Commercial Aspen Strands	Commercial Aspen Wafers
Core Material	Paper Birch	Paper Birch
% Core Material	33	33
% Face Material	67	67
Furnish Moisture Content	3%	3%
Target Densities (PCF)	37, 40, 43	37, 40, 43
Resin Spread (lb/1000 ft^2 surface area)	Face - 1.3 Core - 1.4	Face - .99 Core - .99
Resin Type	Liquid PF	Powder PF
Wax Content (Emulsion)	1% Solids	1% Solids
Press Cycle (Minutes)		
Time To Stops	1.00	1.00
Time At Stops	6.00	5.50
Decompression Time	0.50	0.75
Press Temperature (°F)	400	400

RESULTS

The results of this study are in Table 3. Generally speaking, thin birch strands and wafers, particularly the thin-wide, resulted in OSB and WB properties that were equal to or better than those of the all-aspen OSB and WB. More specifically, for the critical core properties of IB, TS, and ITS, the thin-wide strands and wafers resulted in panels that were superior to the all-aspen OSB and WB.

The thick strand and wafer geometries generally had deleterious effects on IB, TS, and ITS. Although the various core geometries should have had little effect on MOR and MOE, the thick-wide geometries did cause some MOR and MOE reductions in both OSB and WB. The thin birch geometries resulted in MORs and MOEs statistically equal to those of the all-aspen OSB and WB.

MORs and MOEs after the 2-hour boil bond durability test generally were not affected by core type except that the MOR of the thick-wide OSB was statistically lower than the other four OSB types. LEs after the boil test were the same for four of the five WBs; the thick-wide birch core wafers resulted in a statistically higher LE. LEs of the four OSB birch core types were approximately the same but somewhat greater than that of the all-aspen OSB. Cross-LEs were statistically greater for the OSBs made with the two thick birch strands.

SUMMARY

The excellent performance of WBs and OSBs with cores made from thin-wide paper birch strands and wafers suggests that a feasible design for a two-species three-layer OSB or WB would be aspen strands/wafers for the faces and thin-wide birch strands/wafers for the cores. This design, if adopted by OSB and WB manufacturers, would help reduce the aspen shortfall predicted for the year 2000.

Research on this project continues. We will be using the best paper birch core geometry, which is the thin-wide, and then will determine minimum acceptable resin spreads, maximum thicknesses of "thin" strands/wafers, maximum amounts of birch for the cores, advantages if any of mixing aspen with birch for the cores, and advantages if any to be gained by manipulating the press cycle and mat moisture content.

Table 3.--Predicted mean values for selected properties of laboratory oriented strandboards (OSB) and waferboards (WB) at 40 PCF density.

	Modulus of Rupture (psi)				Modulus of Elasticity (1,000 psi)				Internal Bond (psi)		Thickness Swelling (percent)			
Core	OSB		WB		OSB		WB		OSB	WB	OSB		WB	
Type	non-aged	aged[1]	non-aged	aged[1]	non-aged	aged[1]	non-aged	aged[1]			Total	Irrev.	Total	Irrev.
thick-narrow	5880	2930	3850	2180	1050	551	653	358	57	83	34	22	38	25
thick-wide	4830	2850	3930	2380	944	539	611	385	75	74	30	18	35	23
thin-narrow	5200	2700	4430	2200	964	508	610	370	95	84	28	16	34	22
thin-wide	5680	2820	4150	2070	1020	538	613	326	92	91	26	14	28	16
com-mercial aspen	5960	3340	4210	2470	1030	621	613	380	83	80	31	18	33	21

[1]Tested wet after a 2-hour boil bond durability test.